Initiatives in Analysis Methods

Eugene Z. Stakhiv, Ph.D.
David A. Moser, Ph.D.
U.S. Army Corps of Engineers
Institute for Water Resources

US Army Corps of Engineers

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Institute for Water Resources

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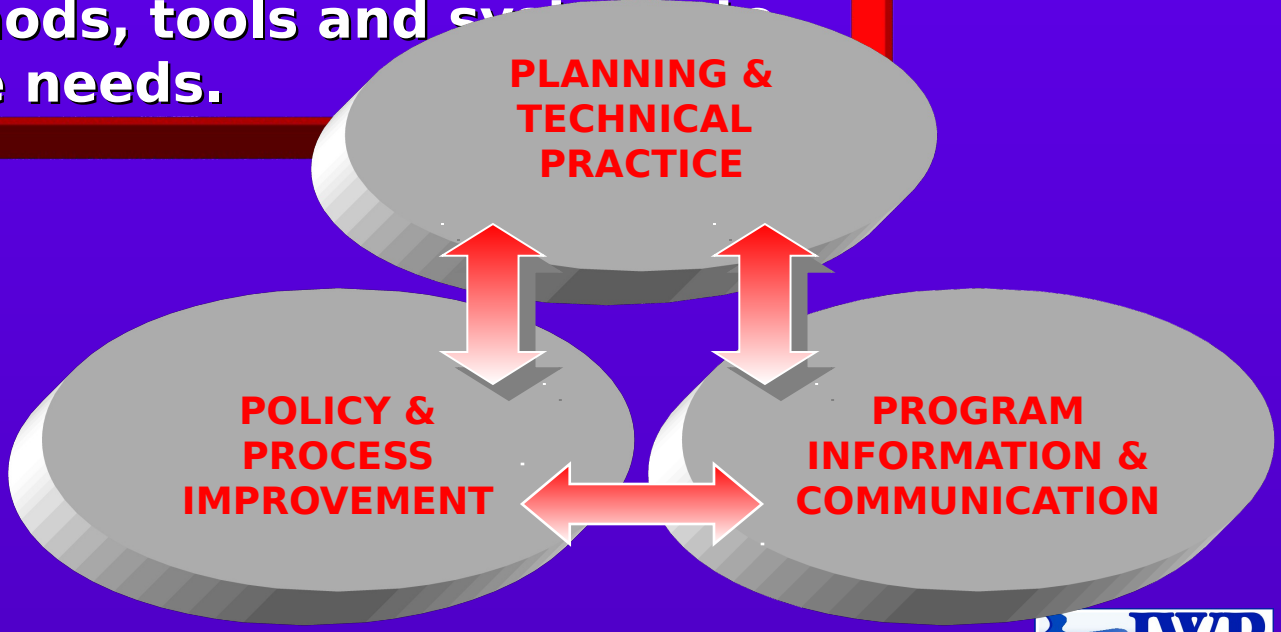
IWR MISSION

To support Civil Works by anticipating changes in national water resources conditions, and to develop and apply new planning evaluation, hydrologic engineering and information management policies, methods, tools and systems to address these needs.



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IWR EXPERTISE

The Institute has subject matter [illegible] a range of specialties.

planning

- Plan Formulation
- National Economic Development (NED) & Regional Economic Analyses
- Decision Support & Risk Analysis
- Environmental Evaluation
- Policy & Program Analysis
- Public Involvement & National Outreach
- International Water Resources
- Shared Vision Planning
- Alternative Dispute Resolution
- Drought Preparedness
- Climate Change & Variability
- Regulatory Program
- Wetlands Mitigation Banking

H&H

- Surface Hydrology
- Hydrologic Statistics
- River Hydraulics
- H&H Forecasting
- Reservoir Systems
- Water Management Control

Navigation

- Waterborne Commerce Statistic
- Lock Statistics & Navigation Infr
- Dredging Information
- Information Systems Design
- Trade & Fleet Forecasts
- Maritime Transportation
- Navigation Systems Analysis

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Improvements for EBA (Environmental Benefits Analysis)

"White Paper" Mar 2001

TRACK 1 – Improve Current Procedure

- Analytical Protocol for NED/NER analysis
- Link evaluation to broader range of ecological models

TRACK 2 – Next Generation

- Develop NER/EQ account to reflect "goods and services" approach
- Expand ecological models to include process (simulation) models
- Initiate interagency dialogue

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Near Term Protocols

	Small Studies/Projects	Large Studies/Projects
Single Purpose	*e.g.*, CAP 1135, 206,204	*e.g.*, 1103, Ohio River, CWPPRA
	•Ecological analytical methods (e.g., HEP, IBI) •Economic framework •Cost allocation •Cost sharing	•Ecological analytical methods (e.g., IBI ,HEP, HGM) •Economic framework •Cost allocation •Cost sharing
Multipurpose	*e.g.*, Challenge 21 (Sec 212)	Everglades, Louisiana 2050, Lake Ontario/St Lawrence
	•Ecological analytical methods (e.g., HGH, HEP) •Economic framework •Cost allocation •Cost sharing	•Ecological analytical methods (e.g., IBI ,HEP, HGM) •Economic framework •Cost allocation •Cost sharing

“Next Generation”

- EBA Report
- Develop NER/EQ Accounting Framework for “environmental goods and services”
- Improve Ecological evaluation methods, especially process simulation models (for larger projects)
- Corps Economic & Environmental Wkshop
- Interagency Workshops

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Precursors to EBA

- Policy Study: “New Directions for Corps Environmental Activities” (1993)
- Policy Study: “Incremental Cost Analysis” (1995)
- Policy Study: “Civil Works Environmental Action Plan” (1995)
- Policy Study: “Sustainable Development Concepts” (1998)
- NRC Report on Corps Planning (1999)
- Policy Study: “Implementation Steps for SD (’02)

Context for Decisionmaking

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PLANNING
(Multiobjective River Corridor Management

Protection
(Regulatory Program)

- SAMPS
- ADIDS
- General Permits
- Nationwide Permits
- No Net Loss of Wetlands
- Wetlands Mitigation
- Banking

Development
(GI Program)

- Flood Damage Reduction
- Water Supply
- Navigation Channels, Dredging
- Reservoir Reallocation
- Ecosystem Management

Management
(O&M Program)

- Environmental Restoration
- Dredging Material Disposal
- Drought Contingency Planning
- Dam Safety
- Lock and Dam Rehabilitation
- Reservoir Systems Optimization

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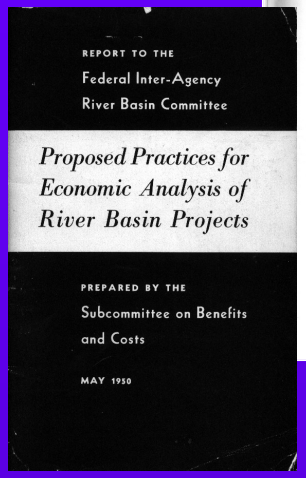
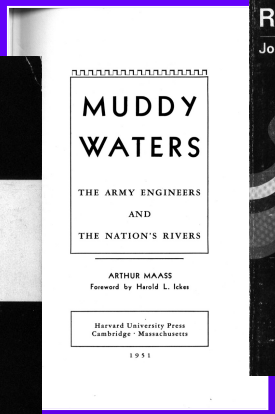
Existing Planning/Evaluation Paradigms

- **Descriptive** (NOAA/CZM, McHarg, GIS)
- **Indicative** (normative, P&S/P&G, BCA)
- **Prescriptive** (regulatory "planning")
- **Proscriptive** (to avoid, NEPA/EIS)
- **ERSATZ** ("Ecorestoration sitting around the table *Zeitgeist")* (see EPA Watershed guide)
- "**Garbage Can" Planning** (see Ersatz)



1950



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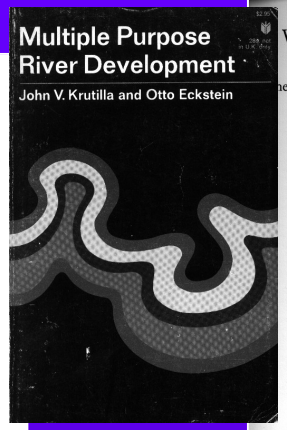

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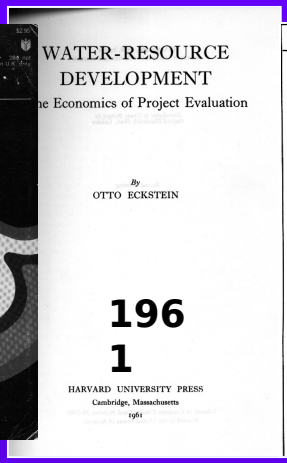
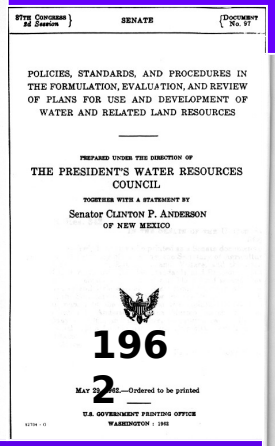
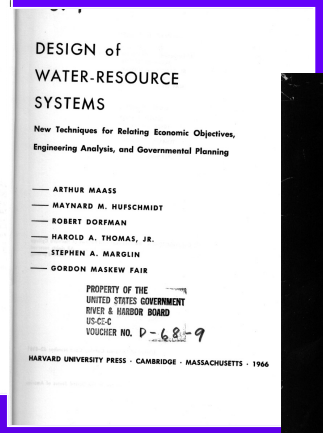
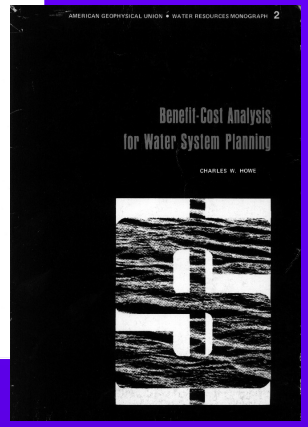


1961



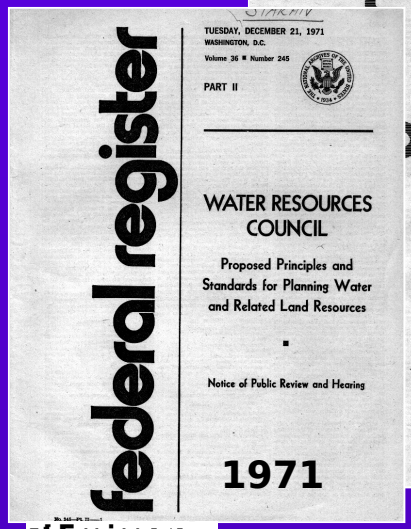
1962



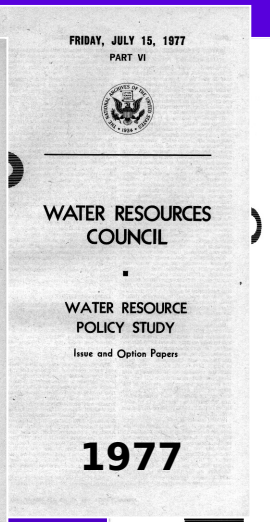

AMERICAN GEOPHYSICAL UNION • WATER RESOURCES MONOGRAPH 2
Benefit-Cost Analysis
for Water System Planning
CHARLES W. HOWE

1971

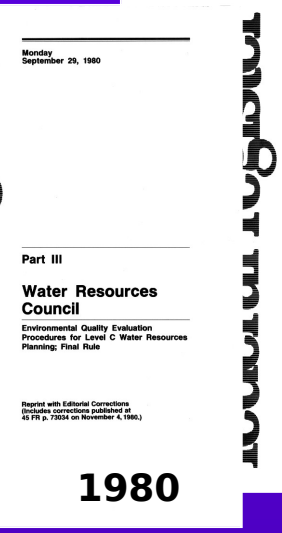
EVOLUTION OF FEDERAL WATER RESOURCES PLANNING GUIDELINES

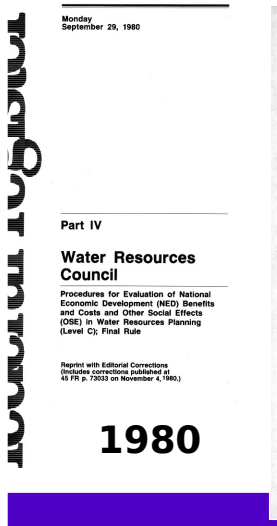


1971

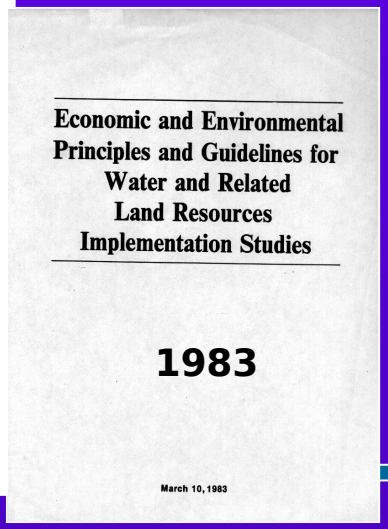


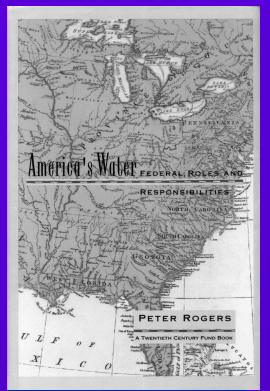
1977





1980





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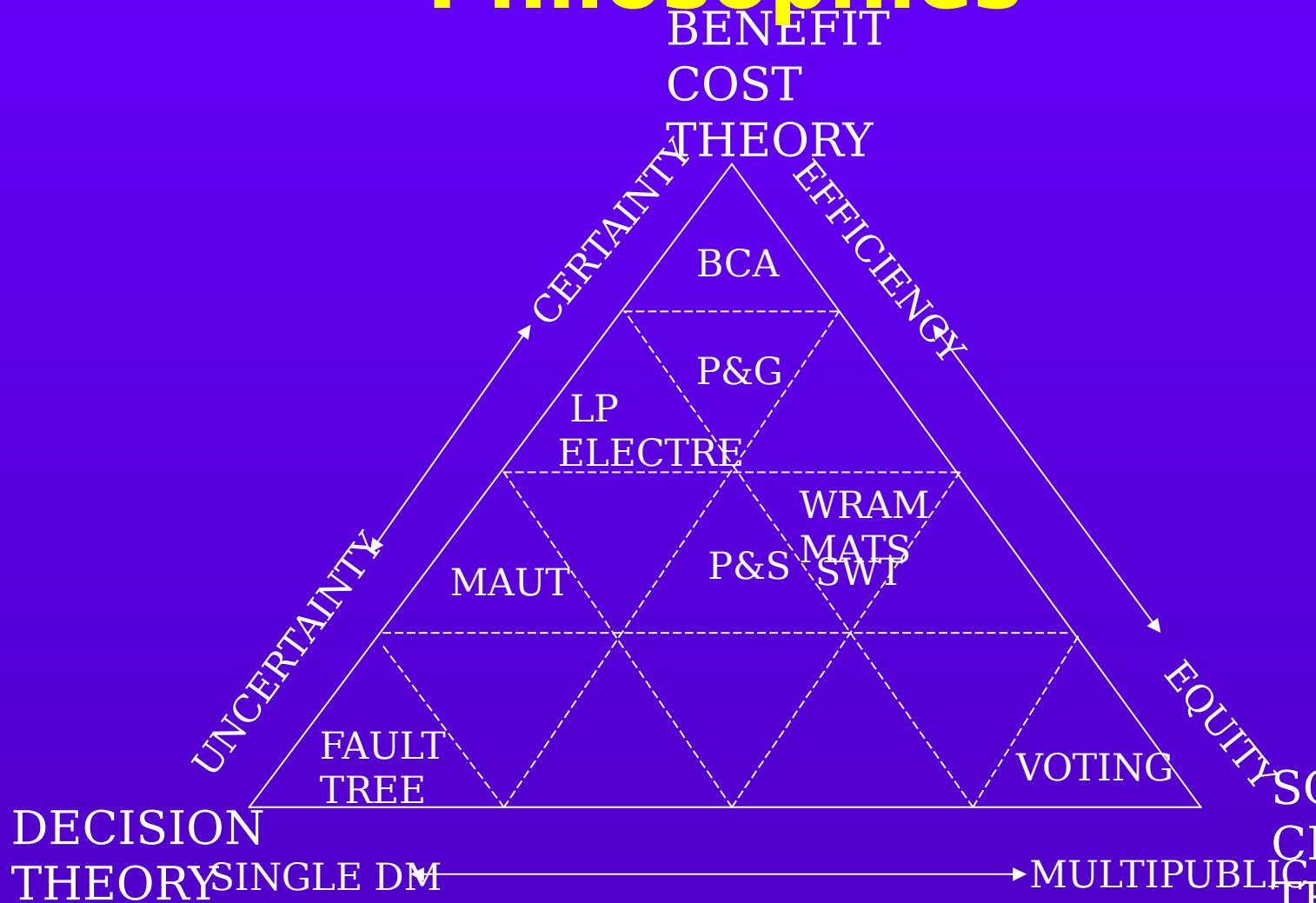
Normative Evaluation Philosophies



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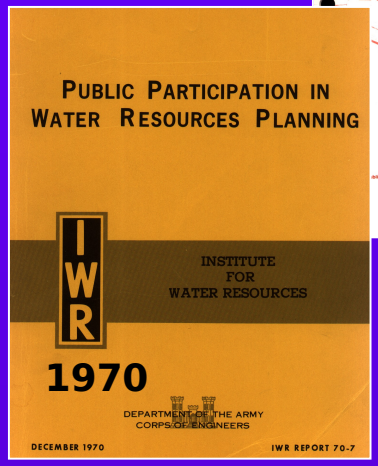
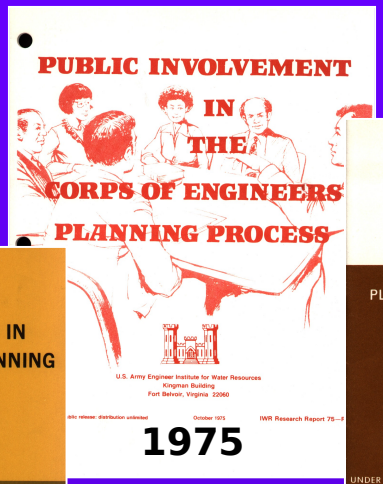
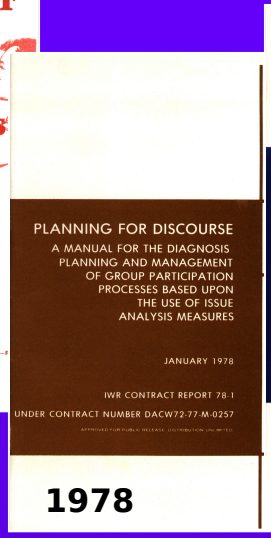
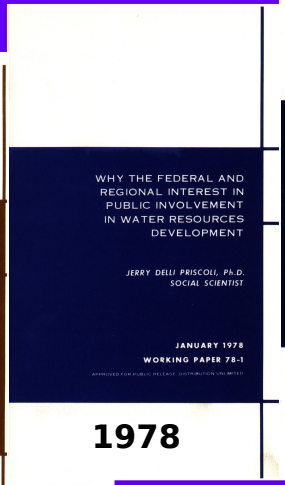
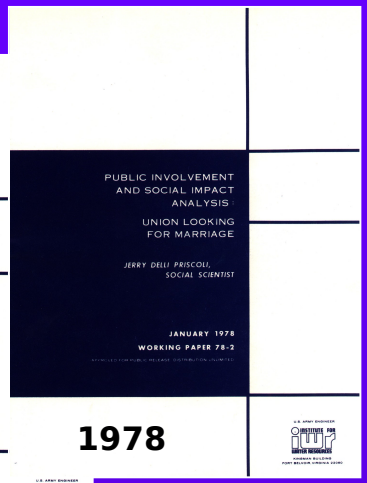
EVOLUTION OF PUBLIC PARTICIPATION/ADR IN THE CORPS PLANNING PROCESS

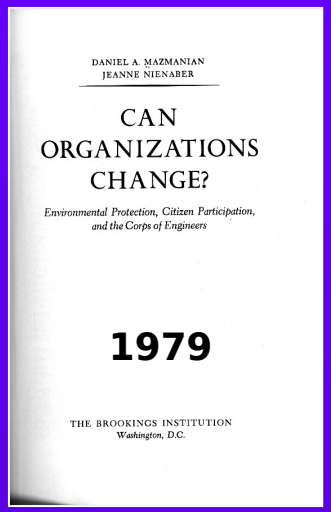


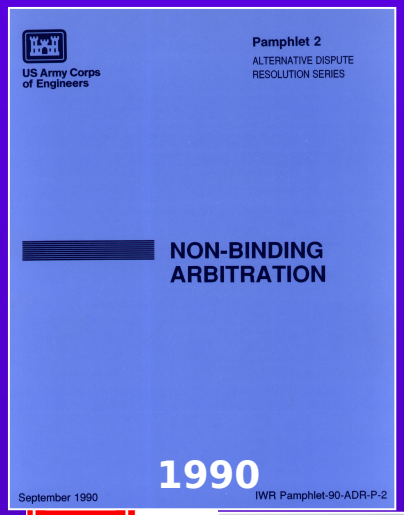

PUBLIC INVOLVEMENT IN THE CORPS OF ENGINEERS PLANNING PROCESS
U.S. Army Engineer Institute for Water Resources
Kingman Building
Fort Belvoir, Virginia 22060
1975

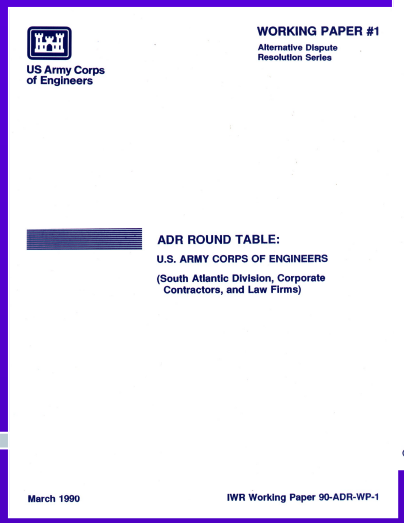

PLANNING FOR DISCOURSE
A MANUAL FOR THE DIAGNOSIS PLANNING AND MANAGEMENT OF GROUP PARTICIPATION PROCESSES BASED UPON THE USE OF ISSUE ANALYSIS MEASURES
JANUARY 1978
IWR CONTRACT REPORT 78-1
UNDER CONTRACT NUMBER DACW72-77-M-0257
1978

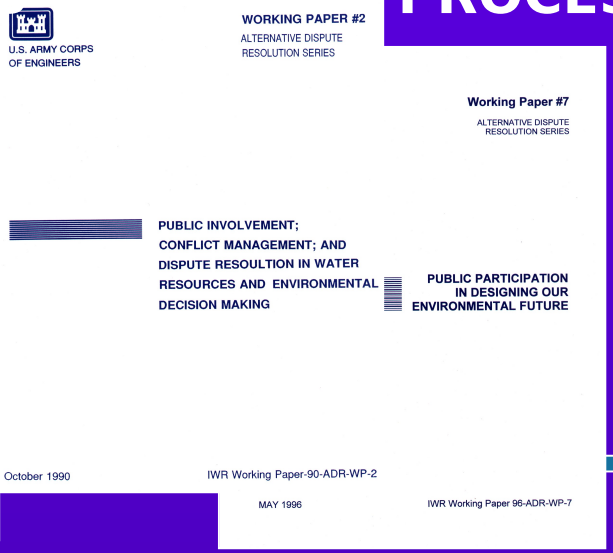

WHY THE FEDERAL AND REGIONAL INTEREST IN PUBLIC INVOLVEMENT IN WATER RESOURCES DEVELOPMENT
JERRY DELLI PRISCOLI, Ph.D.
SOCIAL SCIENTIST
JANUARY 1978
WORKING PAPER 78-1
1978

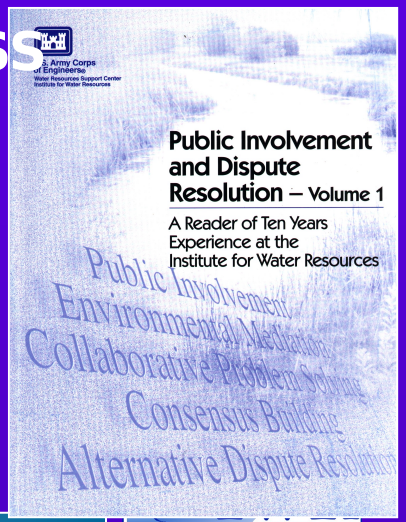







US Army Corps of Engineers
WORKING PAPER #1
Alternative Dispute Resolution Series
ADR ROUND TABLE:
U.S. ARMY CORPS OF ENGINEERS
(South Atlantic Division, Corporate Contractors, and Law Firms)
March 1990
IWR Working Paper 90-ADR-WP-1


U.S. ARMY CORPS OF ENGINEERS
WORKING PAPER #2
ALTERNATIVE DISPUTE RESOLUTION SERIES
Working Paper #7
ALTERNATIVE DISPUTE RESOLUTION SERIES
PUBLIC INVOLVEMENT; CONFLICT MANAGEMENT; AND DISPUTE RESOULTION IN WATER RESOURCES AND ENVIRONMENTAL DECISION MAKING
PUBLIC PARTICIPATION IN DESIGNING OUR ENVIRONMENTAL FUTURE
October 1990
IWR Working Paper-90-ADR-WP-2
MAY 1996
IWR Working Paper 96-ADR-WP-7
1996


Public Involvement and Dispute Resolution – Volume 1
A Reader of Ten Years Experience at the Institute for Water Resources
Public Involvement
Environmental Mediation
Collaborative Problem Solving
Consensus Building
Alternative Dispute Resolution
INSTITUTE FOR WATER RESOURCES
1998

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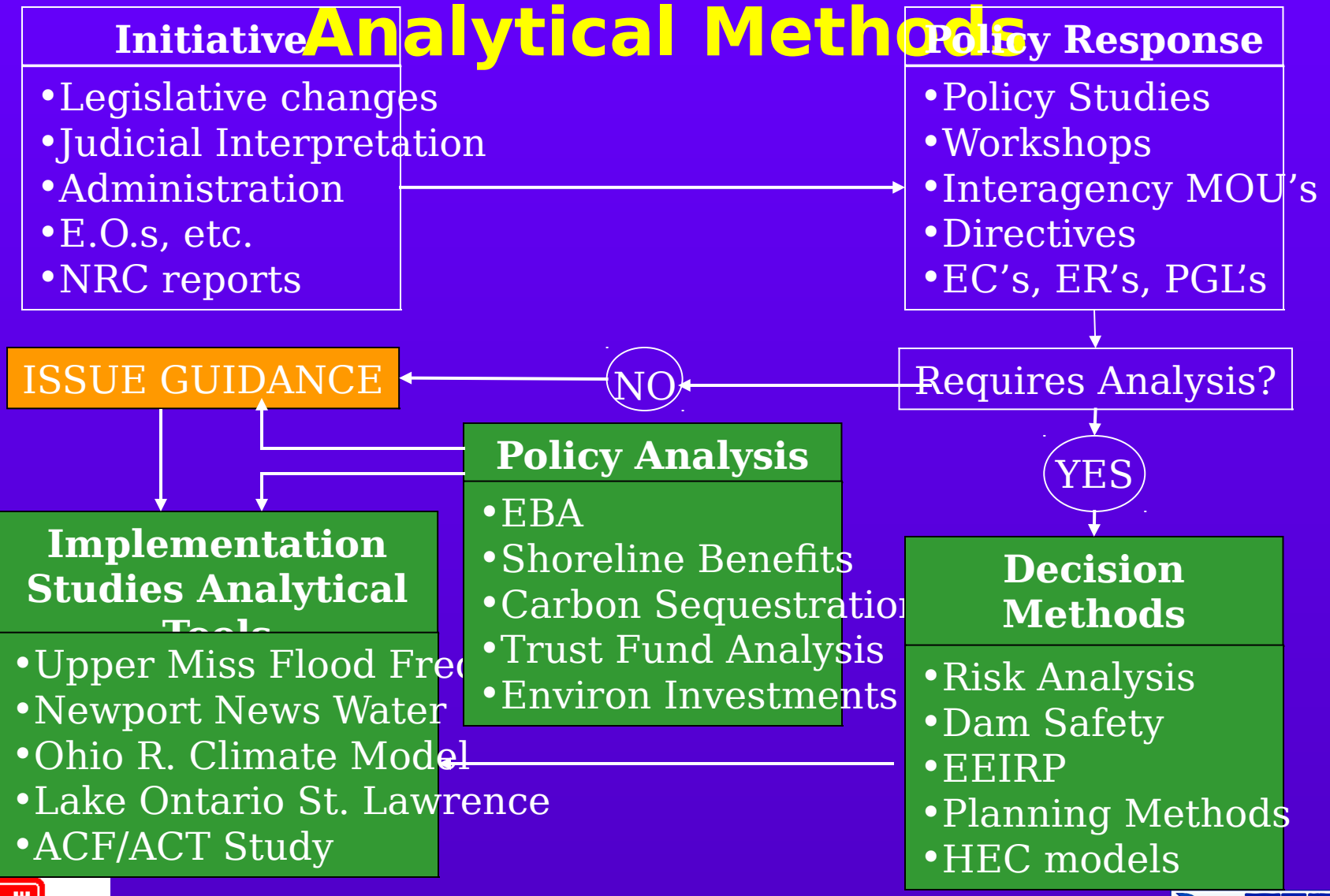
Process for Developing Analytical Methods



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IWR National Studies

- National Hydropower Study (1978-82)
- National Waterways Study (1979-83)
- National Drought Study (1991-95)
- Nat. Wetlands Mitigation Banking (93-96)
- Federal Infrastructure Strategy (93-96)
- Nat. Shoreline Study (2002-2007)

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National Drought Study
(1992-96)

- Report to Congress 1995
- National Drought Atlas (use L-moments)
- Shared Vision Planning applied to 5 areas
- IWR-MAIN water demand forecasting
- 20 technical reports
- Analysis of California Drought Impacts

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Multiobjective Planning/
Harvard Water Program
1962/P&S/P&G/ -
Updated IWR 1994

Adaptive Environmental
Management
C.S."Buz" Hollings
1978

Shared Vision Model
Richard N. Palmer 1981,
1992

The Shared Vision Model

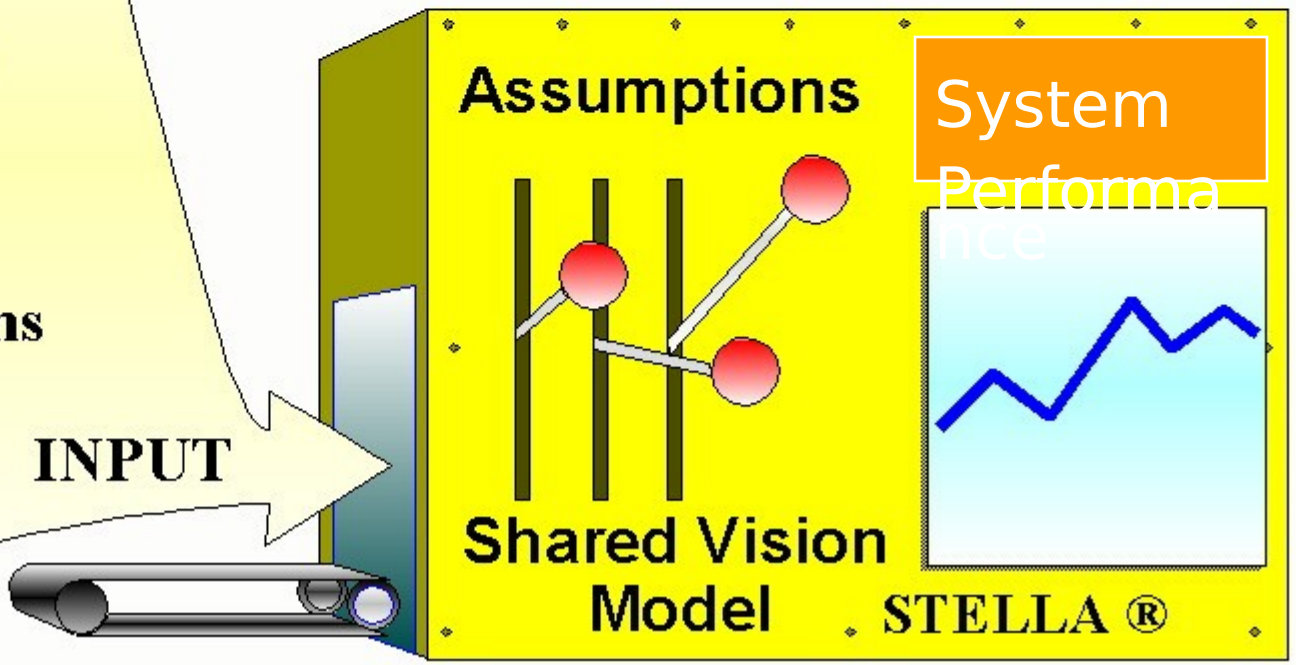
Stakeholder
Value Judgements

Demand Forecasts

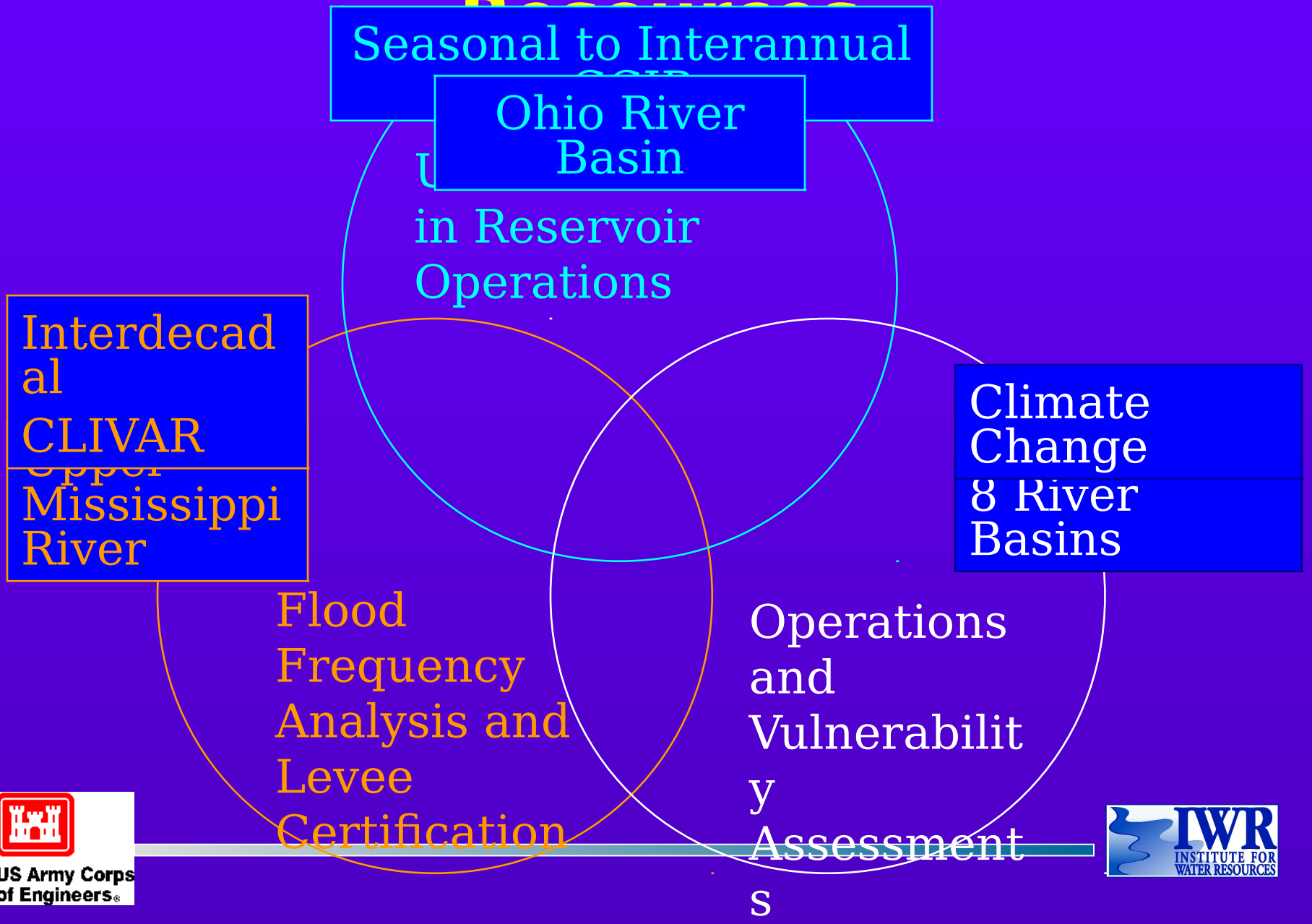
Hydrology

Economic Functions

Environmental
Functions



Time Scales and Water Resources



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Climate Change Analysis

- Intergov. Panel on Climate Change (I,II,III)
- National Climate Assessment (1998-2001)
- Climate Change Impacts on 8 river basins
- Upper Miss. R. Flood frequency Analysis
- Ohio R. Basin Climate Forecasting Model
- World Water Council Climate Forum

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Related Policy Analytics

- US Harbor Traffic Projections
- Corps Civil Works Capital Stock Update
- US Hydropower Capacity Potential
- US Harbor Maint. Trust Fund Analysis
- Envir. Investments Upper Miss Basin
- Emissions Impacts of Navigation

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Goal Objective⇒ Criteria	Sustainable Development				Reduce Vulnerability	
	Econ.	Envir.	Equity	SWB	Safety	Reliability
Mgmt. Measure	$ Costs & Benefit	W.Q. Habitat Diversity	Income Distribution	Relocate	Population at Risk	Frequency of Failure
MM_1						
…						
MM_i						
…						
MM_n						

Management ⇒ (Adaptive) Measures

- Structural / infrastructure
- Legal / legislative
- Institutional / administrative
- Regulations (land use, zoning, standards)
- Education
- Financial incentives, subsi
- Taxes, tariffs, user fees (-)
- Research and development
- Market mechanisms
- Technology development

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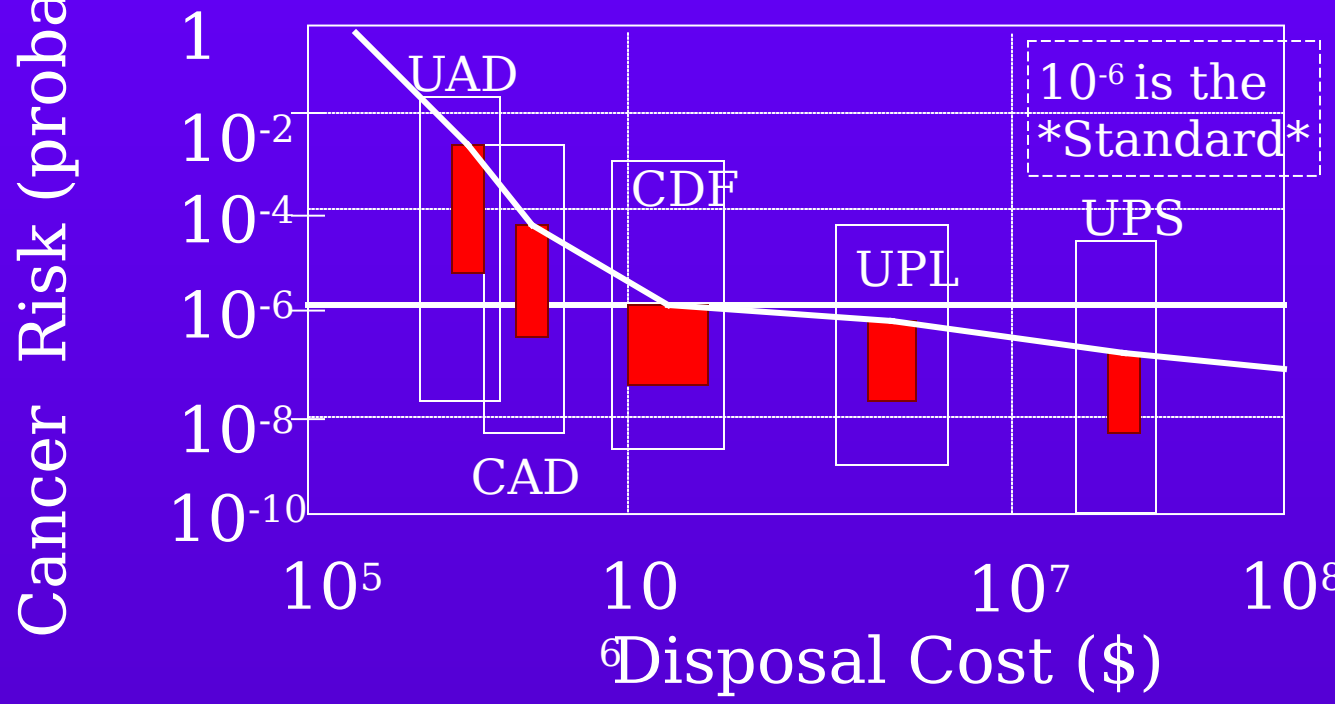
Level 4 Analysis



UAD – unconfined aquatic disposal
CAD – capped aquatic disposal
CDF – confined disposal facility
UPL – upland disposal
UPS – upland source

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Analytical Methods

- Risk Analysis Applications
- Innovations in Navigation Analysis
- Environmental Restoration Evaluation
- Water Use and Water Conservation
- Hydrologic Planning Technologies

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Risk Analysis

- Part of P&S but extended in P&G
- Part of specific evaluation requirements since 1991
  - Implemented by ER's

Major Rehabilitation

- Uncertainty in benefits and costs quantified
  - Analysis equivalent to planning studies
- Life-cycle approach
  - Risk of component failure
- Base condition assumes fix as fail
- Investment strategies beyond immediate rehab required to be formulated

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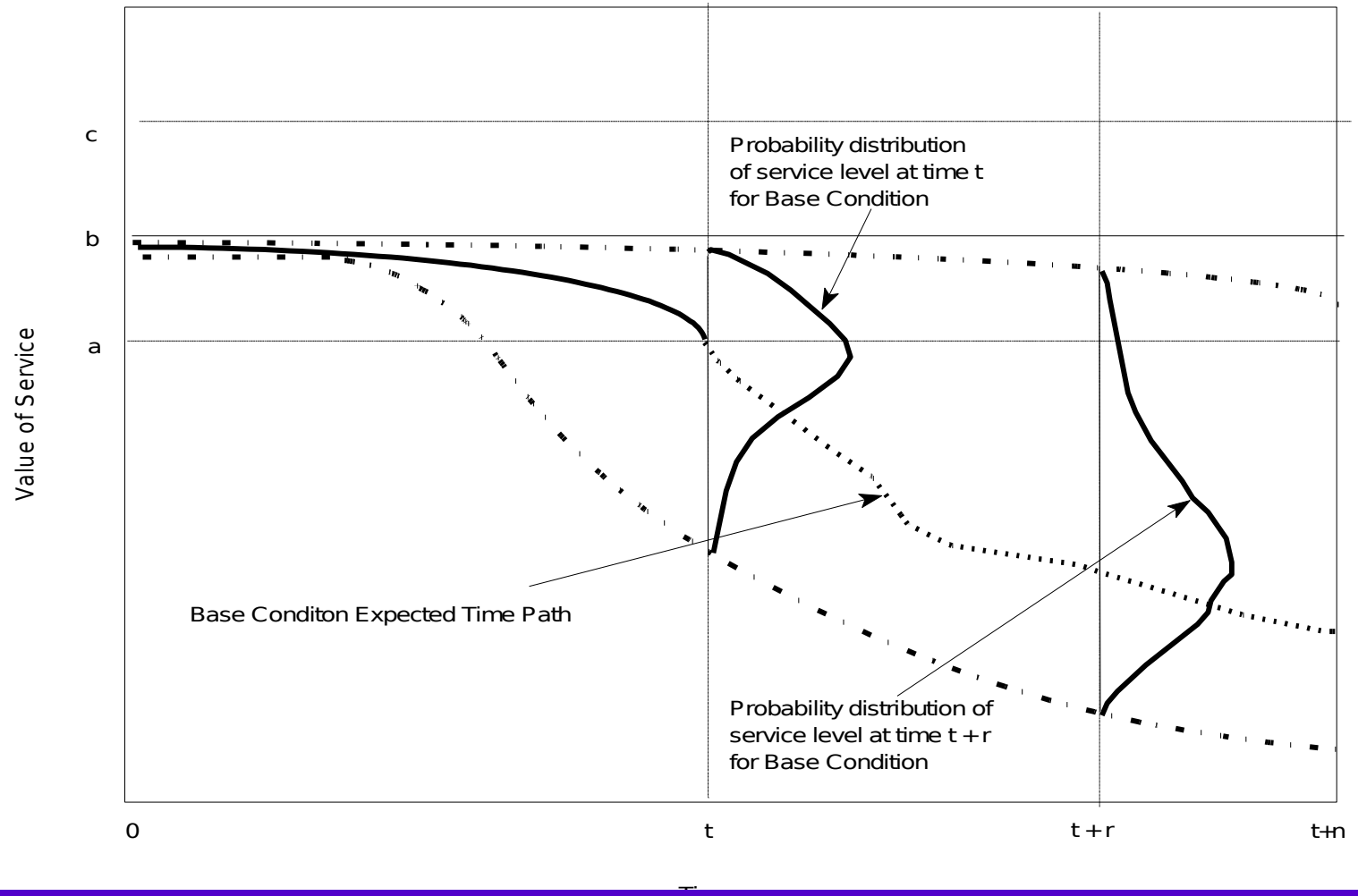
The Base Condition Performance Time Path



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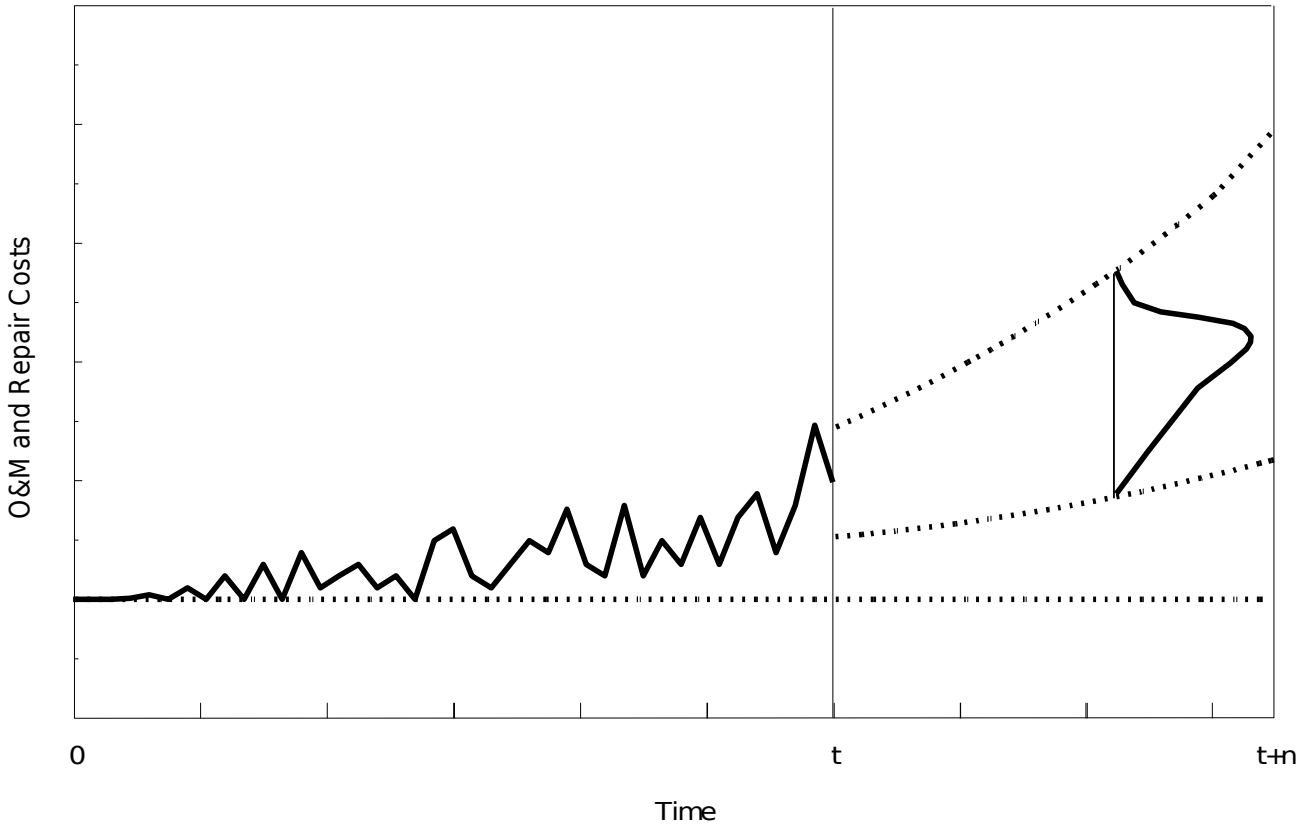
The Base Condition O&M Cost Time Path



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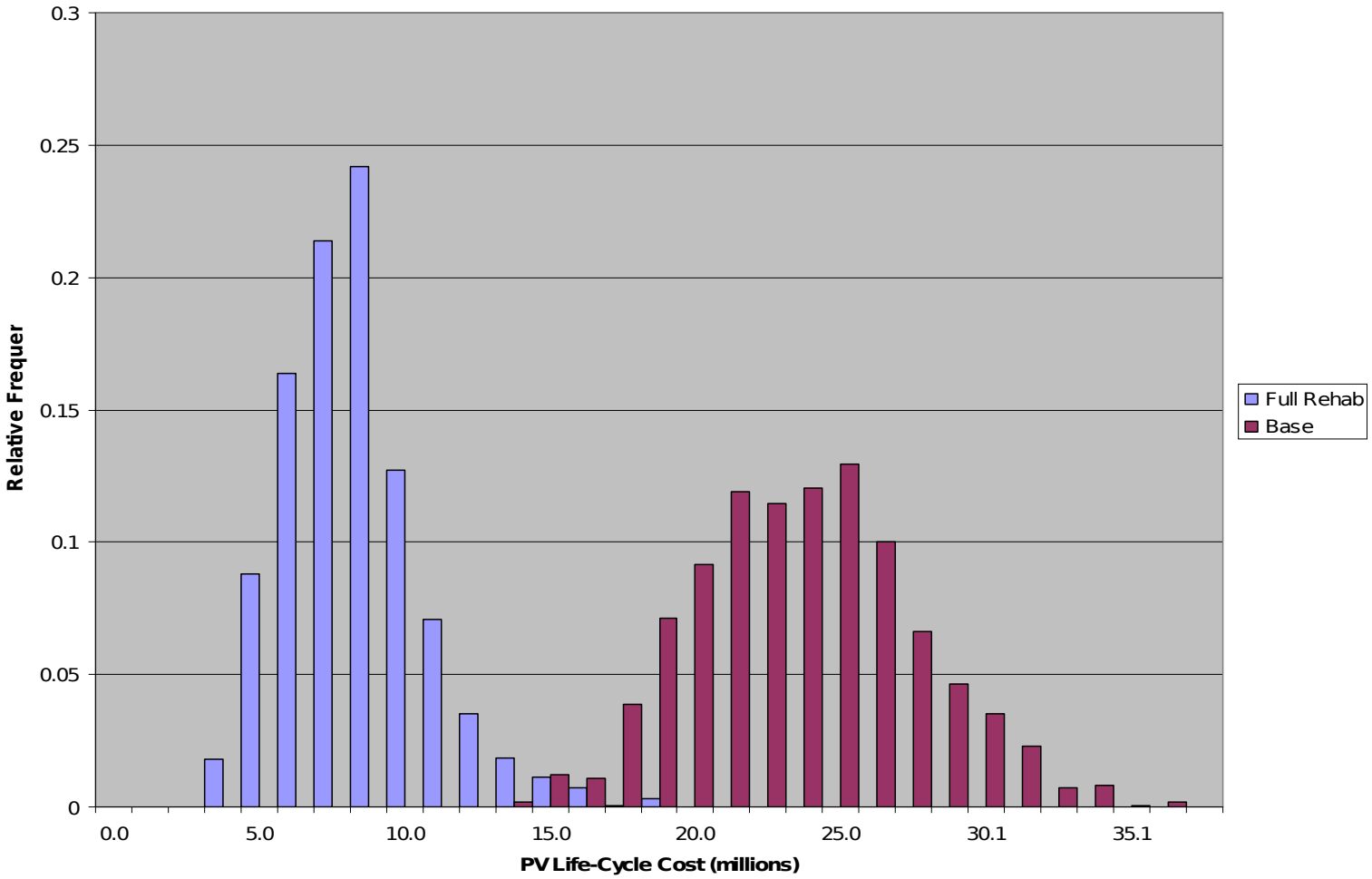
Distribution of Life-Cycle Cost



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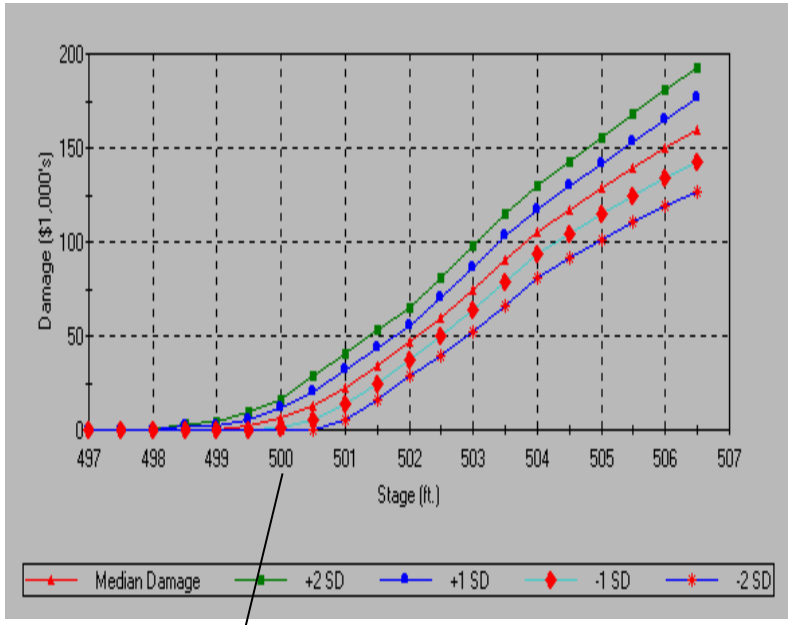
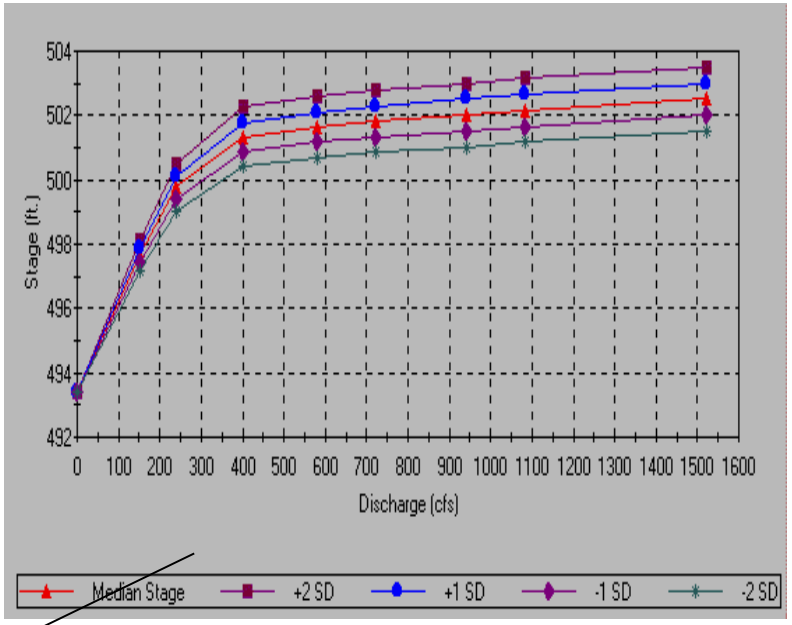
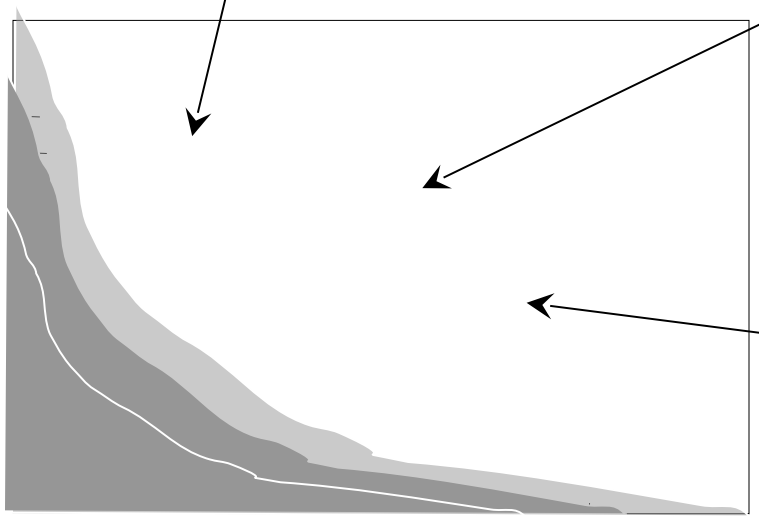
Flood Damage Reduction

- Extended then existing risk analysis approach
  - Quantified uncertainties in discharge, stage, and damage
  - Conjoined uncertainties using Monte Carlo process

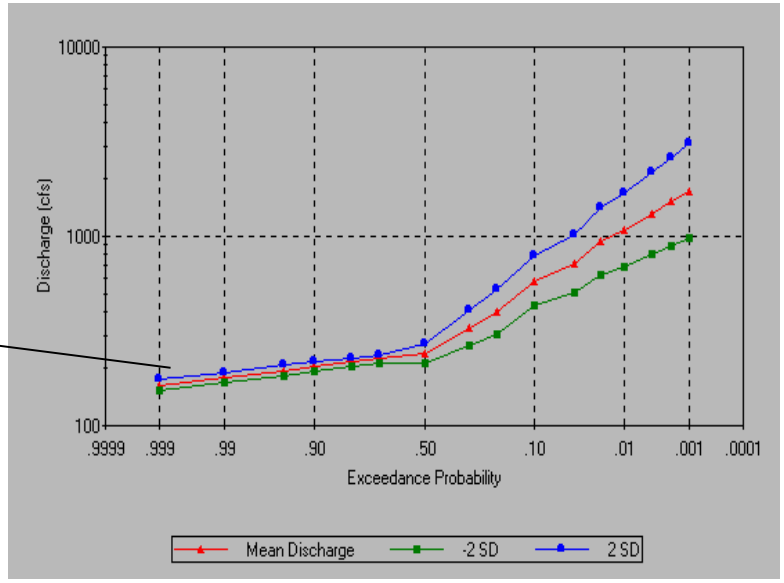




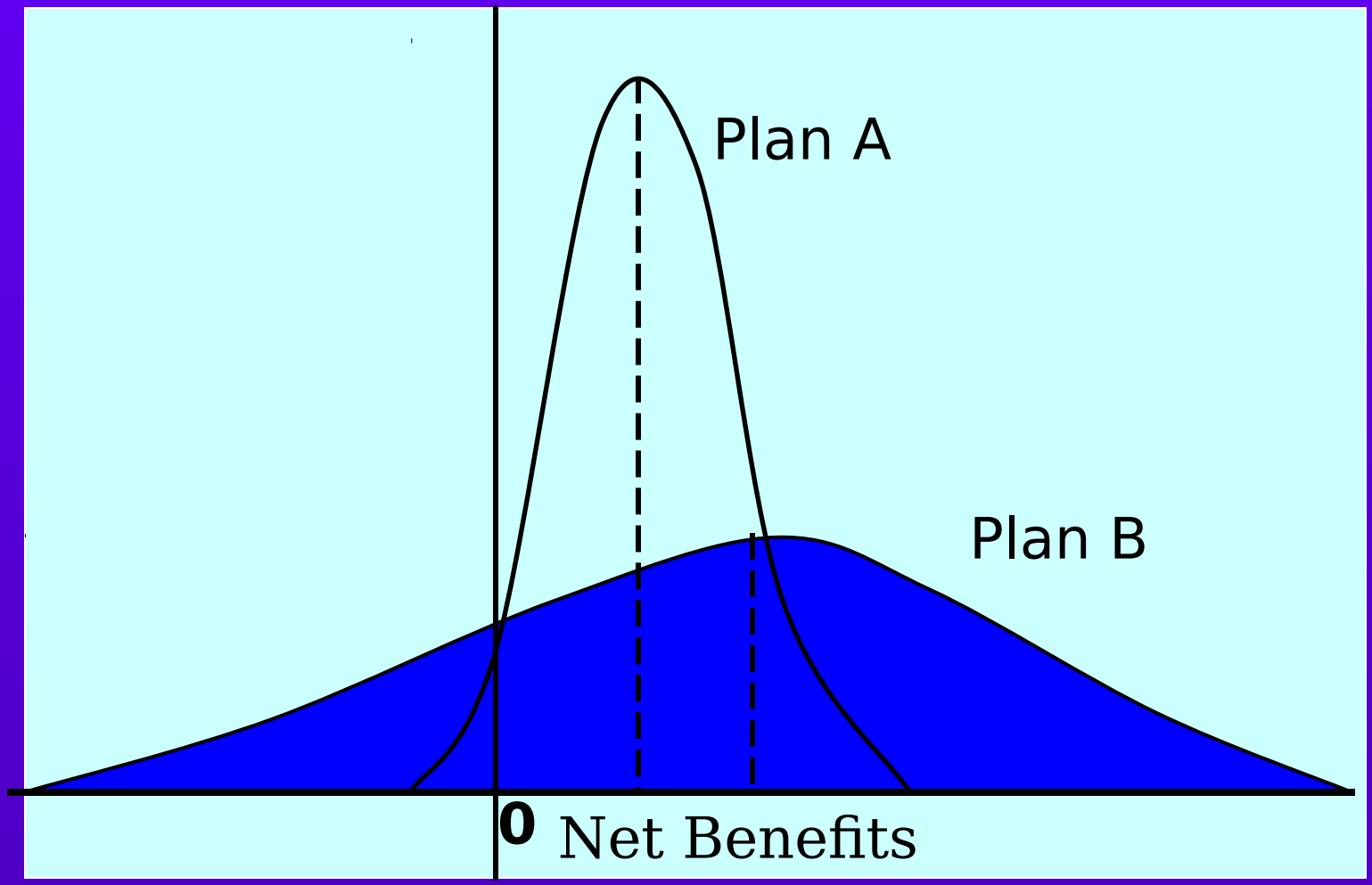


Frequency

Damage



Distribution of Net Benefits



Flood Damage Reduction

- Approach reviewed by NAS committee with report in 2000
- Corps concurred with many suggestions for improvements in method
  - Disagreed with some
  - Funding has not been available to implement improvements

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Dam Safety

- R&D Programs
- 1984-87: Hazard Assessment
- 1999-present: Risk Analysis
- Objective

  Develop methodologies, frameworks and software tools necessary for the USACE to proactively manage the overall level of human and economic risk from our inventory of dams

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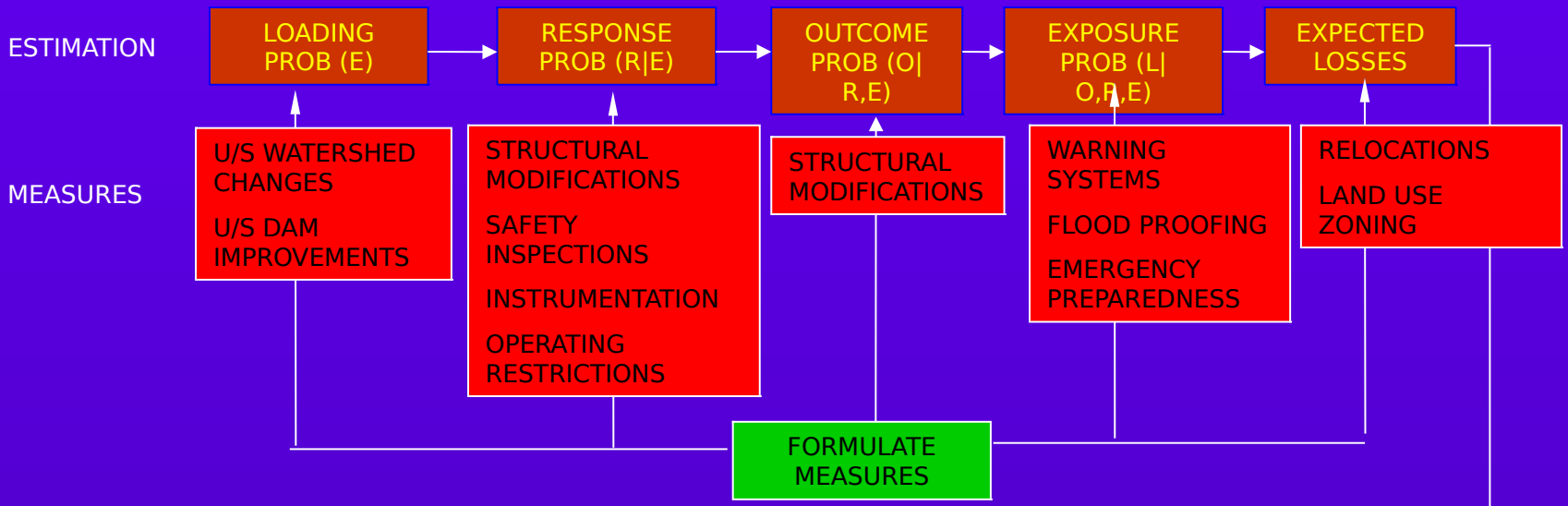
FRAMEWORK FOR RISK ASSESSMENT

	INITIATING EVENT	SYSTEM RESPONSE	OUTCOME	EXPOSURE	CONSEQUENCES
IDENTIFICATION	• STATIC LOADING • FLOOD •EARTHQUAKE •U/S DAM FAILURE •LANDSLIDE	• OVERTOPPING • SLOPE FAILIURE • CRACKING • PIPIING • STRUCT/FND FAILURE	• BREACH • PARTIAL BREACH •NO BREACH	• TIME OF DAY • SEASON • WARNING TIME	• LOSS OF LIFE • ECONOMIC • ENVIRONMENTAL • SOCIAL



Compare residual risk to risk guidelines

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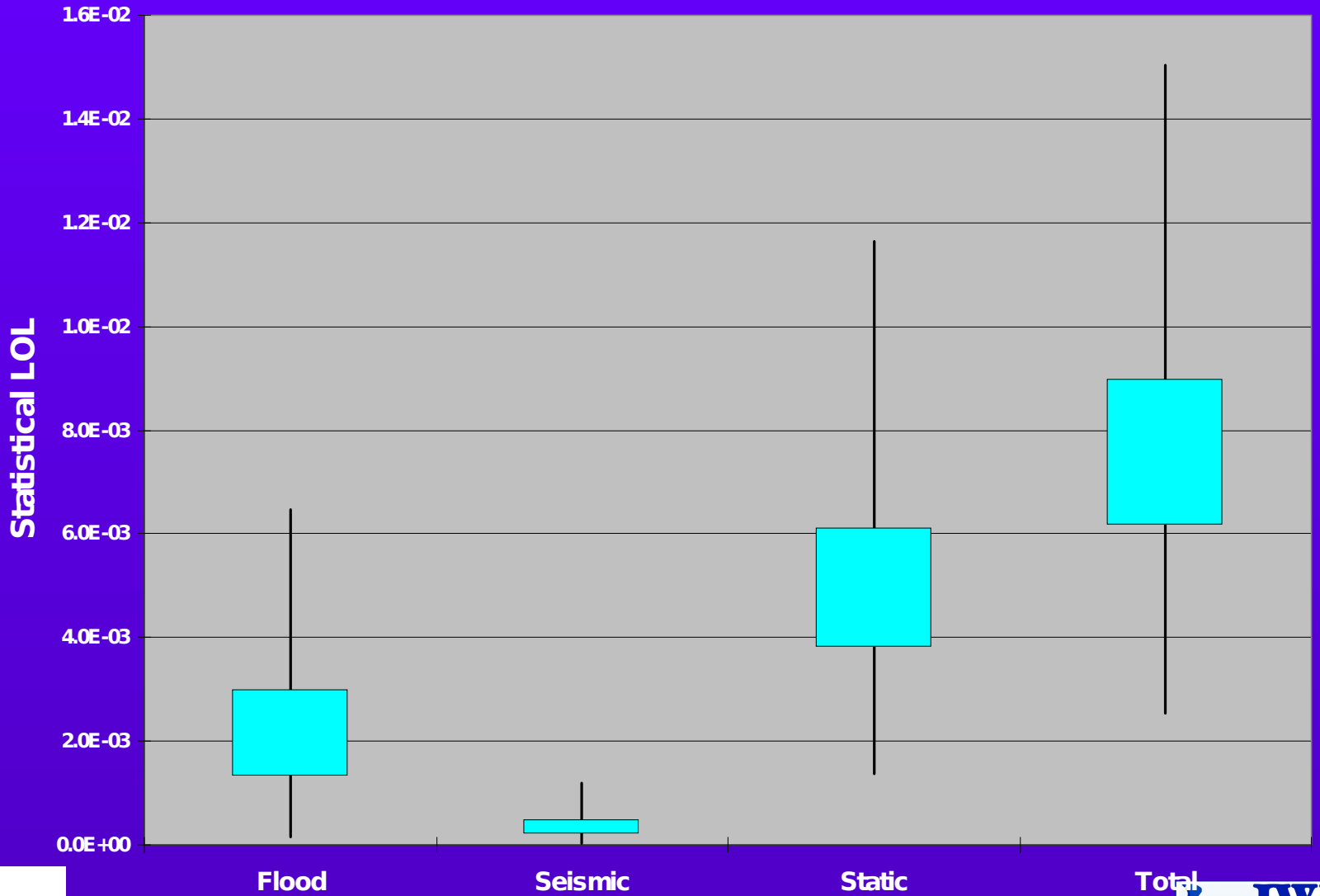
LOL Risk Results



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Innovations in Navigation Analysis

- IWR-NavSym
- Non-traditional Benefits and Costs

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IWR-NavSym

- Discrete event Monte Carlo model
  - Simulates movements of tows along a waterway network.
  - Quantities transportation cost and saving
  - Discrete events:
    - trip generation
    - tows entering a reach (or lock)
    - tows traversing a reach (or lock)
    - tows arrival at destination port

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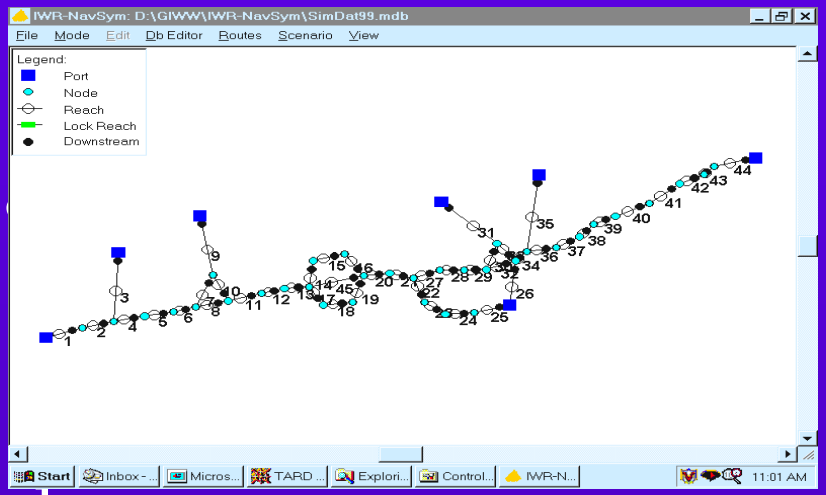
IWR-NavSym

- Risks
  - Casualties
- Uncertainties
  - Trip generation
  - Tow travel time in re
  - Reach choice
- Other factors
  - congestion / traffic rules



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IWR-NavSym and Navigation Improvements

- Reduces Tow Travel Time in Reach
- Reduces Congestion
- Changes Traffic Rules
- New reach / route
- Expressed in Model as Data for:
  - reaches
  - tow transit time in reach

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Non-traditional Benefits and Costs

- Each transportation mode has energy-use and environmental characteristics that have impacts on the environment
- National Economic Development evaluation tools and procedures can be developed to assess at least part of economic benefits and costs of modal shifts

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Emission Reduction Benefit

- District studies
  - Soo Locks
  - Chickamauga Lock
- IWR has developed a framework for analysis to estimate with and without project emissions.
- Studying the value of reduced carbon emissions and the health cost of increased pollutants

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Proposed Extensions

- Change In Emission Profile
  - Tools to estimate changes in total emission due to a Corp project
- Affect on human health
  - Evaluate existing method to associate changed emission profiles to human morbidity and mortality
- Place Economic Value on Changes in Emissions.
  - Methodologies to quantify the impacts of changed emission in NED terms

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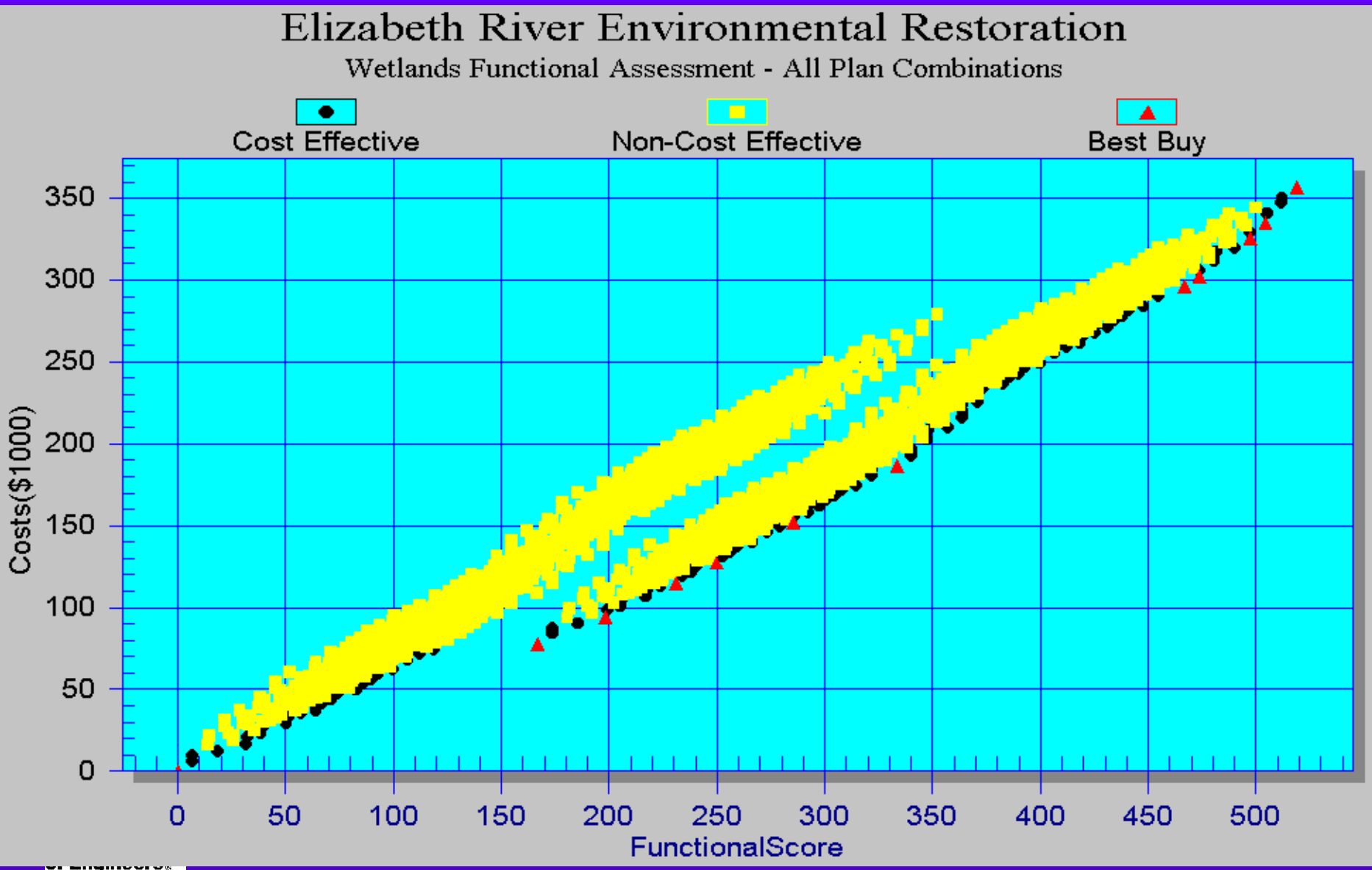
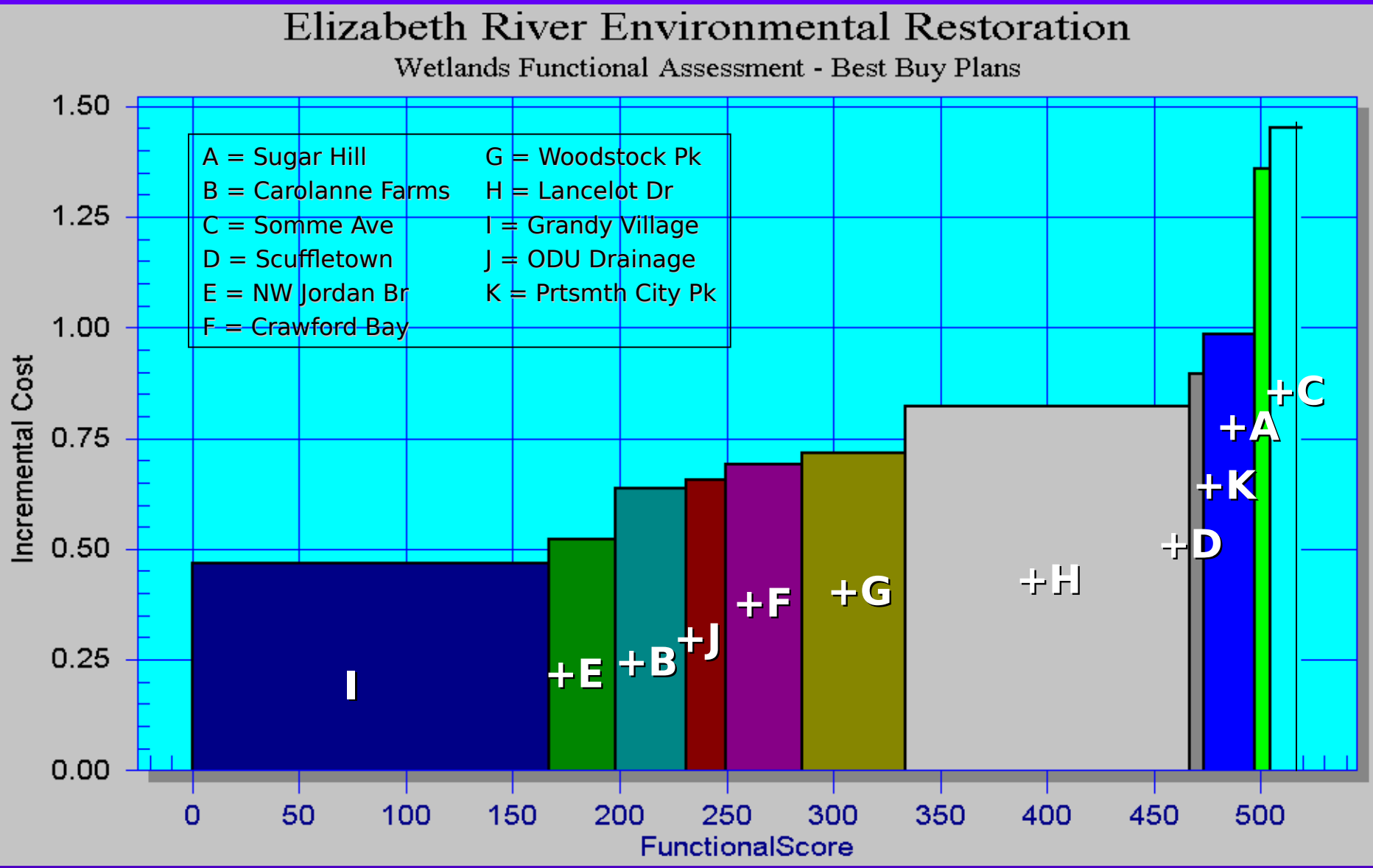
IWR-PLAN

- Assists in plan formulation
  - Builds “all plan combinations”
  - 26 solutions, 20 scales each
  - Dependency & combinability relationships
- Up to 10 variables, including:
  - Costs
  - Outputs
  - Other “effects”
  - “Derived” (combined) outp
- Performs CE/ICA
  - CEA: Cost effective plans
  - ICA: Best buy plans

Formulate All Plan Combinations



Incremental Cost Analysis



MOST CUSTOMERS NOT AWARE OF "WHAT LIES BENEATH"

SINGLE CUSTOMER FOCUS

Base Products/Services, Training & Tech Transfer

National Outreach

National & Special Studies

District Technical Assistance

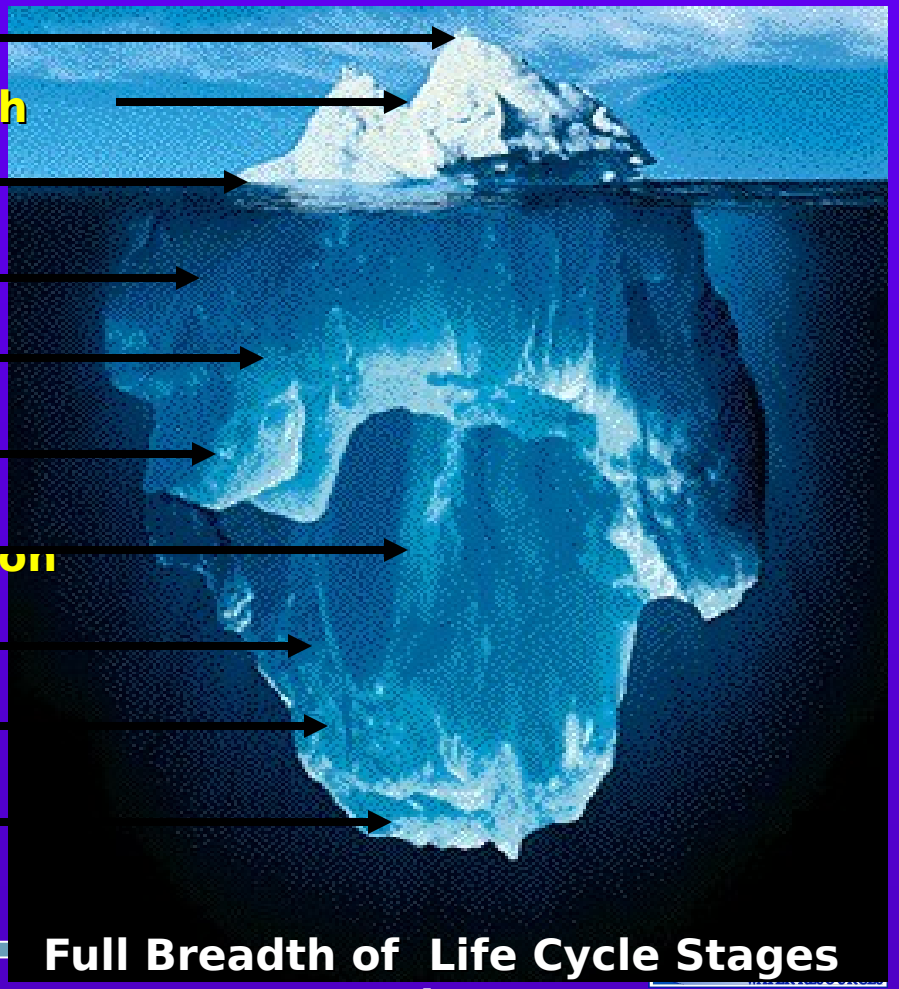
Policy Development

Navigation Data & CW Information

Planning Methods

Software Modeling

Research & Development



Full Breadth of Life Cycle Stages & CW Business Areas

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